Validation Of Rain Rate Retrievals For The Airborne Hurricane Imaging Radiometer (HIRAD)

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Abstract

NASA’s Global Hawk aircraft (AV1) has two microwave sensors: the passive Hurricane Imaging Radiometer (HIRAD), and the active High-altitude Imaging Wind and Rain Airborne Profiler (HIWRAP). Results are presented for a rain measurement validation opportunity that occurred in 2013, when the AV1 flew over a tropical squall-line that was simultaneously observed by the Tampa NEXRAD radar. During this experiment, Global Hawk made 3 passes over the rapidly propagating thunderstorm, while the TAMPA NEXRAD performed volume scans every 5-min. In this poster, the three-way inter-comparison of HIRAD Tb, HIWRAP dbZ and NEXRAD rain rate imagery are presented. Also, observed HIRAD Tbs are compared with theoretical radiative transfer model results using HIWRAP Rain Rates.

INTRODUCTION

• HIRAD is a collaborative effort of NASA MSFC, CFRSL, and Univ. of Michigan
• HIRAD & HIWRAP flew on an unmanned Global Hawk UAV, in NASA’s Hurricane and Severe Storms Sentinel (HS3) flight program
• Sept 2013 AV1 flew over a tropical squall-line of thunderstorms in the Gulf of Mexico, near Tampa Bay
  – These rain events were simultaneously observed by NOAA’s National Weather Service NEXRAD

INSTRUMENTS OVERVIEW

HIRAD
• Provides mapping of hurricane surface wind field and rain structure
• IFOV ~2km @ Nadir & 5km @ edge of swath
• 1-D Synthetic Thinned Aperture Radiometer with 40 km swath

HIWRAP
• Dual freq (Ka- & Ku-band), dual-beam, conical scan Doppler Radar
• Measures line-of-sight & surface winds from volume backscattering of clouds & rain

RESULTS

• Results demonstrate an excellent correlation in the 3-way comparison of spatial patterns:
  • NEXRAD rain rate, HIRAD Tb @ 5 GHz and HIWRAP dbZ
  • HIWRAP Z-R relationship tuned to NEXRAD rain rates
  • HIRAD observed Tb calibration tuned to radiative transfer model (RTM) calculations
  • HIRAD Tb forward RTM uses the 3D rain patterns inferred by HIWRAP

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